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Evaluation of Parkia Seed Extract as Preservative against Fungi

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ABSTRACT
The feasibility of using spent water from parkia seed (iru) processing were tested on wood samples of *Ceiba pentandra* as preservative against fungi. Spent water (leachate) from locally produced iru processing was used to treat Ceiba wood. Wood samples were at the sawmill unit of Forest Products Development and Utilization Department of Forestry Research Institute of Nigeria (FRIN). Wood samples converted into 15 mm x 15 mm x 25 mm and were inoculated with *Sclerotium rolfsii* and *Pleurotus florida* for 12 weeks. Samples soaked for 48 hours had the lowest weight loss (7.143%) for samples inoculated with *P. florida* thus signifying that the leachate at 48 hours of soaking provided preservative property against *P. florida* while the 24 hours of soaking was the least effective. But samples inoculated with *S. rolfsii* show that the leachate was not effective in the control of *S. rolfsii*.

Introduction

Wood is a biological material which (under proper condition) will give century of service but given condition that favours its biodeterioration [1], wood can be destroyed by biodeteriorating agent such as termite, fungi and bacteria. Wood as a biological material is degraded by bacteria, fungi and termites [2,3]. Some wood species however have resistance to these degrading agents while others are very susceptible to deterioration [4]. Those that are susceptible must be treated with preservative chemicals to increase their service life. The organisms that can degrade wood are principally fungi, insects and bacteria. Molds, most sapwood stains, and decay are caused by fungi, which are microscopic, thread-like microorganisms that must have access to organic material to live. For some of them, wood offers the required food supply. The growth of fungi depends on suitable, mild temperatures, moisture, and air or oxygen [1]. Decay fungi will only grow and develop within a fairly limited range of wood moisture contents 20% to 50% [5].

Generally wood have been and are still being treated with synthetic chemical with their attendant toxicity both to man and the environment. Concerns about the safety and environmental impact of preservatives used to protect wood from biodegradating agents have increased in the recent years [6, 7, 8]. As postulated by [9] that in the future there will be reduction in the use of preservatives containing arsenic, chromium, creosote and pentachlorophenol; and probably in the longer term preservatives containing copper. In parallel with this, the trend is for introduction of a much broader suite of alternatives, with main focus on organic preservatives. Early studies of preservative leaching tended to focus on the ability of a preservative to provide long-term protection. Efficacy of preservative depends on absorption and retention in the wood and leaching studies remain an integral part of research to evaluate potential of new preservative systems [10]. However, international restrictions are limiting the use of non-biodegradable chemicals for wood preservation, primarily due to disposal problems associated with treated wood taken out of service [11]. In recent times, the attention of researchers have been drawn to the problem of environmental pollution particularly contamination of soil and water resources is considered as a major risk for human communities throughout the world [12]. As observed by [13] that there were drawbacks on the use of copper compounds, which include copper tolerance exhibited in a number of fungal species, possible corrosion to metal fasteners and aquatic toxicity. It is therefore, pertinent to harness knowledge base on potent organic materials for the development of environmental friendly wood protecting chemicals [11, 14].

Similar studies have been reported indicating that some wood, plant, seed and fruit extracts were utilized to increase the durability of wood species such as heartwood extract [15, 16, 11], wood extract, cinnamon (*Cinnamomum cassia*) bark extract [17] pepper (*Piper sarmentosum*) extract [18] and water pepper (*Polygonum hydropiper*) extract [19]. Ceiba wood is one of the non-durable wood species with very low density; wood of ceiba is light (300kg/m3 at 12-15%mc), soft and fibrous, lower in strength and coarser [20, 21, 22]; it is known to degrade at log yard and even on stacking. It finds application in form work in construction work. Parkia extract were found to be effective in the control of termite as in [23, 24]. This study focuses on the efficacy of parkia seed leachate as a preservative chemical for the control of *Pleurotus florida* (a white rot fungus) and *Sclerotium rolfsii* (brown rot fungus).

Materials and Method

Leachate (spent water) from *Parkia biglobosa* seeds processing (commonly called "iru" among the Yoruba's) were collected from the local producer after cooking period of 13 hours. The Local leachate (LSL) was used to treat the wood samples at two periods of soaking namely 24 and 48 hours. Clear *Ceiba pentandra* wood were selected from the sawmill unit of Forestry Research Institute of Nigeria and were converted into 15 x 25 x 50 mm [25] and oven dried at 650C

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until a constant weight was recorded and denoted as *T1*. 5 samples were assigned to each of the soaking period (24 and 48 hours) and for both fungi inoculation as well as for the untreated samples; making a total of 25 samples. Samples were then soaked in the leachate for 24 hours and 48 hours respectively. At the end of the treatment period, the samples were withdrawn and allowed to condition for 72 hours.

Fungi for the inoculation *S. rolfsii* and *P. florida* were collected from the pathology section of Forestry Research Institute of Nigeria. The fungi (*S. rolfsii* and *P. florida*) were then inoculated on the wood samples inside inoculation chamber in the presence of spirit lamp. The rate of preservative absorption was determined using the weight of the samples before and after the preservative treatments as used by [26]. Weight of treated samples were taken and recorded before the inoculation with the fungi.

$$\% \text{ Absorption} = \frac{T_2 - T_1}{T_2} x100$$

Where T1 = oven dry weight of samples

T2 = weight of treated samples

The wood samples were inoculated with wood decay fungi brown rot (*Scelrotium rolfsii*) and white rot (*P. florida*). The inoculation was carried out at temperature 28±20C for the incubation of the fungi on the wood samples. Observations on weight loss were determined at the end of 12th week of inoculation period. The weight loss after the inoculation period was recorded as *T*3. Percentage weight loss was determined as shown below and used for the analysis of the effect of the fungi on the wood samples.

$$\% \text{ weight loss} = \frac{T_1 - T_3}{T_1} x100$$

Where T1 = Oven dry weight

T3 = Oven dry weight after exposure to fungal attack.

At the end of inoculation period, the samples were cleaned and oven dry to constant weight and recorded.

Results and Discussion

Table 1. Analysis of Table variance for samples inoculated with *S. rolfsii*

Source of variation	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	102.432	2	51.216	2.274	0.145ns
Within Groups	270.240	12	22.520		
Total	372.673	14			

Significant at α = 0.05

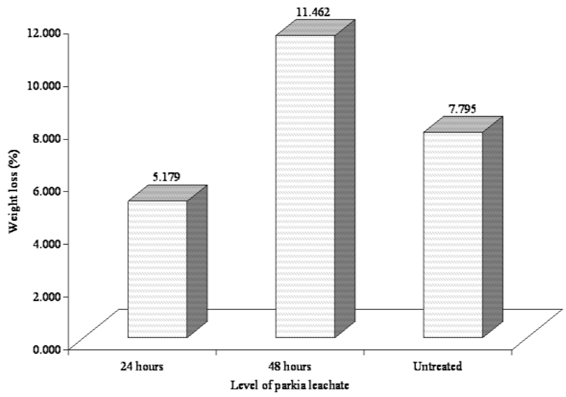

Figure 1. Percentage weight loss

As reported by Femi-Ola, *et. al.*, (2008) and Bolarinwa, (2012) that parkia seed extracts were effective in the control of termite, however from table 1 above, the effect of Parkia leachate shows that the extract is not effective in the control of the brown rot fungus; since the p value 0.145 is not significant. The reason for this may be due to the fact that species of brown rot fungi are usually more active than white rot fungi hence, were able to still act on the wood samples. The figure 1 above shows that there were differences in the weight loss of samples soaked for 24 hours and 48 hours with samples soaked for 48 hours showing the least resistance to *S. rolfsii*; which mean that the 48 hours of soaking did not offer any advantage in respect to absorption and retention of the LSL. However, the analysis in table 1 shows no significant differences in weight loss between the treated and untreated samples of Ceiba. Though percentage absorption was higher for the samples soaked for 48 hours (17.47%) as shown in figure 2 below, yet it did not offer a better protection as it has the highest percentage weight loss (11.462%). This is in consonant with Zyani, (2011) whose work shows that out of the five essential oil extract from five species namely; *Melaleuca alternafolia, Thymus vulgaris, Origanum compactum*, *Eugenia caryophyllat* and *Ocimum basilicum* used against decay wood fungi. Essential oils from *M. alternafolia and T. vulgaris* were only active against one fungus (*Penicillium commune*). Similarly as in [28] which also found out that surprisingly, the polar wood which showed the highest retentions for all the extracts from bark of *Acacia mollissma, Shinopsis lorentzii* and *Pinus brutia* did not perform well in terms of mass loss values. In other words, the higher retention of the extracts tolerated the deteriorating agent, which can be inferred from the result that the higher absorption of parkia seed leachate tolerated the growth of *S. rolfsii*.

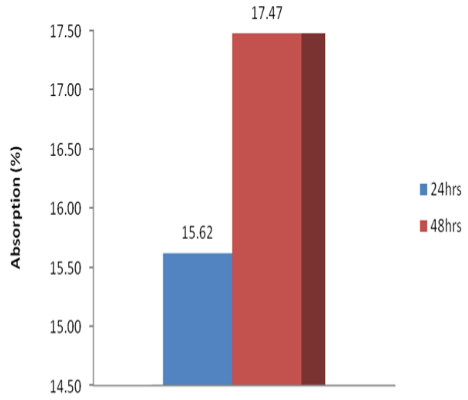

Figure 2. Absorption of parkia seed leachate

Table 2. Analysis of variance for samples inoculated with *P. florida*

Source variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	185.852	2	92.926	4.487	0.035*
Within Groups	248.520	12	20.710		
Total	434.372	14			

Significant at α = 0.05

Table 3. LSD Follow up test

Level of leachate	Mean
48 hours soaking	7.143 a
Untreated samples	14.414b
24 hour soaking	14.791b

Note: mean with same letter are not significantly different

Result of the follow up test (LSD) in table 3 shows that the samples soaked for 48 hours was most effective in the control of *P. florida* while the samples soaked for 24 hours was not effective in the control of *P. florida.* This is because the differences in the percentage weight loss between the untreated and samples soaked for 24 hours were not significantly different as shown in table 2 and 3.

The results of the analysis of percentage weight loss of samples as imparted by the parkia seed leachate presented in table 2 and 3 for the effect of white rot fungus show that the samples soaked in the parkia seed leachate significantly affected the activity of the white rot fungus as shown in table 2 above. Thus the parkia leachate was effective in the control of white rot (*P. florida*) fungus, this corroborate the work of Femi-Ola *et. al.,* (2008) and Bolarinwa, (2012) which found that parkia seed extract had deleterious properties on termites exposed to its extract; they also found out that as the concentration of aqueous parkia seed extracts increases so the deleterious property of the parkia seed extract.

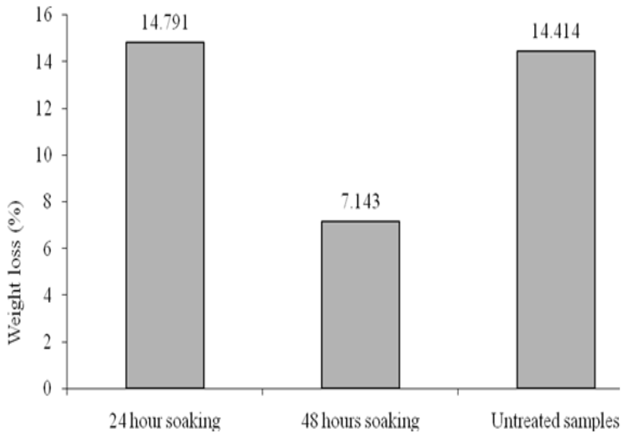

Figure 3. Weight loss as a result of absorption of parkia seed leachate

The lowest percentage weight loss after 12 weeks of inoculation with *P. florida* was observed with the samples soaked in parkia seed leachate for 48 hours (7.143%) as seen in figure 3. This shows that the longer period enhances the preservative properties of the parkia seed extracts, this agrees with the work of [29]Suleiman and Ogundana (2010) which found out that the inhibitory effects of bitter-leaf aqueous extract on mycelial growth of *Trichoderma viridae, Aspergillus nigar* and *Cephalosphorium spp* increased with increase in contraction, as well as that the treatment was significantly different when compared with the untreated. The result of the study is also in line as in [30] whose laboratory experiment indicated that birch tar oil (10 and 30 % v/v aqueous solution) inhibited growth of wood rotting fungi (*Cylindrobasidium evolvens, Libertella* sp. *Stereum hirsutum* and *Chondrostereum)* on Petri dishes. This work also corroborates the findings as in [30] with the essential oils from *Origanum compactum, Eugenia caryophyllata* and *Ocimum basilicum* inhibiting the growth of wood decay fungi.

Similarly, as in [28] that higher concentration of *A. mollissima* (mimosa) and *S. lorentzii* (Quebracho) had the highest mortality rate of termites 95% and 96.33% respectively. This work also agrees with the work as in [23, 24] that at higher concentration of parkia extract the more effective the leachate on termites. It thus means that the 48 hours of soaking offers more concentration of the leachate as well as more absorption of the leachate. The treated samples soaked for 24 hours were found to be higher in percentage weight 14.791% than the untreated samples 14.414%. The reason for this may be that at that period of soaking much of the active chemical of the parkia leachate may not have been absorbed, thus maybe tolerating the survival of the *P. florida*. And being aqueous extract, resulting in absorption of water content in the leachate than the preservative chemical needed to impart the preservation. Since the moisture content required for fungi to thrive is between 20 to 50% M.C., the samples soaked for 24 hours must have provided the required moisture content since the untreated samples were inoculated at oven dry condition.

However, as reported in [31] that alcohol and water extracts of *Cymbopogon citratus, Ceiba pentandra* and *Loranthus bengwelensis* by disc diffusion and agar dilution techniques had anti-fungal properties against *Epidermophyton flocosum, Microsporum canis, Trichopyton rubrum* and *Candida albicans.* This may be the reason the parkia leachate at 24 hours of soaking did not prove effective against the untreated samples, since the presence of phytochemical in Ceiba has been reported to have anti-fungi properties. Since the untreated samples weight loss were lesser than the weight loss for sample soaked for 48 hours. The possibilities of some of the active chemicals in the wood being dissolve in the leachate at the period of soaking is another reason the 24 hours soaking may have been the least effective, as well as the fact that possibility of the phytochemical reported in [31] to have dissolved in the water content present in the parkia leachate.

Conclusion

The study therefore has been able to add to the arrays of biological extracts suitable as wood preservative chemicals. The study carried out shows that parkia seed leachate is not an effective treatment against *S. rolfsii* as well as higher absorption of the leachate will further make *Ceiba pentandra* wood more susceptible to *S. rolfsii.* From the study as well parkia seed leachate has been shown to be effective in the control of *P. florida*. Samples soaked for 48 hours proved effective in preserving *Ceiba pentandra* wood against the white rot fungus as against *S. rolfsii*. Therefore, the work has shown that biological extract are effective as wood preservative and can be used instead of the toxic or hazardous synthetic preservative chemicals.

Further study is to be conducted on natural resistance of *Ceiba pentandra* against bio assay of fungi.

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